

## SCIENTIFIC NOTE

**INSECT MEALS FROM A LEPTODACTYLID FROG  
(AMPHIBIA: LEPTODACTYIDAE)  
IN DOMINICAN AMBER (MIOCENE, 23 MA)<sup>1</sup>**Scott R. Anderson<sup>2</sup>

Dominican amber is renowned for both its clarity and taxonomic breadth of biological inclusions. Nearly every insect order and a variety of small vertebrates have been found in Dominican amber. Though insects are sometimes observed with vertebrate inclusions, most are not directly associated with the vertebrate, simply being victims of the same entombment. A few vertebrates have been observed with dipteran larvae surrounding them (Grimaldi, 1996; Poinar and Cannatella, 1987), showing that the decay was in progress when entombment occurred. The stomach contents consisting of several distinct insect meals of a leptodactylid frog in 23 million-year-old Dominican Amber is herein described, and is the first direct evidence of insects associated with a vertebrate during its lifetime.

The partial insects comprising the frog's stomach contents were primarily examined under a binocular/stereo dissecting scope, utilizing a variable zoom range of 15 to 90 times magnification. Lighting was supplied from above (direct) and below (backlighting) in varying intensities. Photography was performed by using a dissecting microscope (Nikon SMZ-10) with a digital camera connected to a personal computer equipped with the software program Auto-Montage. Auto-Montage integrates images taken at slightly different focal planes and endows the newly formed images with extended depth of field. Measurements were taken with a standard ruler calibrated in millimeters.

The stomach contents consisting of several distinct insect meals are located adjacent to the upper surface of the leptodactylid frog's tongue. The tongue is approximately 7 mm long from base to apex. The stomach contents occur on the anterior portion of the tongue, being approximately 3 mm long by 2 mm height. The stomach contents are partially obscured by the well-preserved upper portions of the hind leg (femur and tibiofibula present, as well as muscles, tendons, and skin). Figure 1 shows the location of the leptodactylid frog's tongue and stomach contents: the three lowermost arrows point to the tongue while a fourth arrow indicates the insect meals. Rotation and realignment of the specimen allows for the careful examination of the partial insect within the stomach contents.

The stomach contents can be divided into two main areas: a distinct partial hind leg and a rounded mass of indistinct, partially digested insects, approxi-

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mately 2 mm long by 2 mm wide. The distinct partial hind leg occurs close to the anterior portion of the tongue and is obscured from most views by the femur and skin of the frog. The tarsus, tibia, and a portion of the femur are visible and are all well preserved. The preserved portion of the femur is approximately 1 mm, while the tibia and tarsus each measure approximately 2 mm. A portion of the tarsus is obscured by the rounded mass of insect partials. Though incomplete, the femur is thickened compared to the tibia. The tibia has at least five spines. The spines are relatively long (longer than tibia diameter) and appear movable. Based on the observed characteristics, this insect meal was likely a common ground cricket (Orthoptera: Gryllidae: Nemobininae). Due to the awkward rotation required to view this portion of the stomach contents and the resultant irregular surface created, photography of this feature has not yet proved successful.



Fig. 1 Location of the tongue and stomach contents of the leptodactylid frog entombed in 23 million-year-old Dominican Amber.

The second area of stomach contents that are observed consists of a rounded mass of insect partials approximately 2 mm long by 2 mm height. Though partially obscured by the femur and tibiofibula of the frog, most details of this area are readily observable when the specimen is rotated. Overall, this portion of the stomach contents appears to be a clumping of insect partials in a definite rounded mass. Most of the partial insects are indistinguishable, sclerotized portions of unidentifiable insects, exhibiting little recognizable structure besides the general sclerotized appearance. This is evidence of their partial digestion. One, very well-preserved slightly clubbed, 11-segmented, antenna is observed. A second antenna is also observed (appears to be the counterpart to the well-preserved antenna), but is deteriorated and total number of segments cannot be determined. Figure 2 shows this second area of stomach contents. The very well-preserved, slightly clubbed antenna is designated by an arrow, while a second arrow shows the clumped, deteriorated insect partials.

Though two hymenopterans (families undetermined) are observed within the amber specimen, the partial insects that comprise the stomach contents of the



Fig. 2  
Close-up of second area  
of stomach contents  
(clumped partial insects  
shown in Figure 1).

frog are the only ones located in close proximity to the frog. Their deteriorated appearance shows that they were partially digested. At least two meals are identifiable within the stomach contents, although more are possible based on the general deteriorated state of the insect mass. Regardless of the total number of insect meals, finding both the soft tissue tongue and stomach contents of a fossil frog is phenomenal.

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